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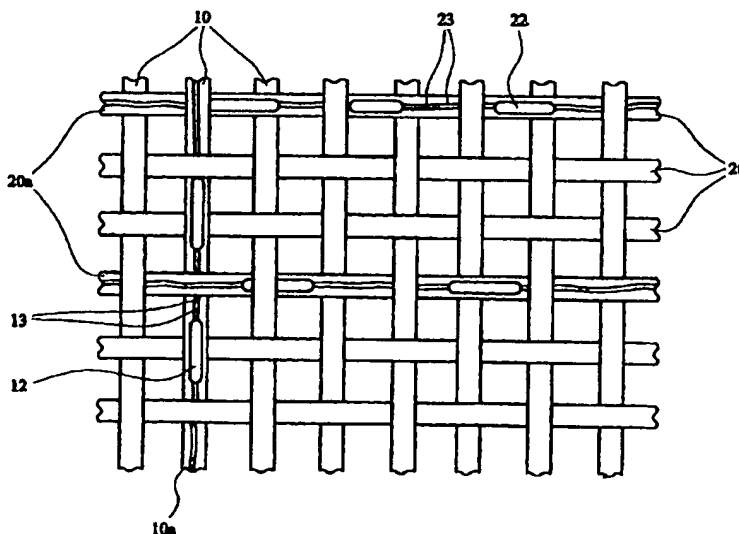
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(54) Title: ELECTRONIC SYSTEMS INCORPORATED INTO TEXTILE THREADS OR FIBRES



(57) Abstract: A textile thread or fibre has a plurality of e.g. electronic elements (12, 22) embedded or encapsulated therein, or a piece of fabric or an e.g. fabric garment has a plurality of elements (12, 22) embedded or encapsulated in textile threads or fibres (10, 20a) thereof, the plurality of elements being interconnected or otherwise intercommunicating to form a signal processing system. This system may comprise, for example, a personal computer system, a personal telecommunications transmitter/receiver system, or a personal television and/or radio system.

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Electronic Systems Incorporated into Textile Threads or
Fibres

The present invention relates to electronic or equivalent signal-processing systems incorporated into textile threads or fibres, or into the textile threads or fibres of a piece of fabric.

5 In one aspect, the present invention relates to personal computer systems, personal telecommunications transmitter/receiver systems and to personal television and/or radio systems: by "personal" is meant for use by an individual person, whether for commercial business or his own private
10 affairs.

The use of mobile personal computer systems and personal (mobile) telephones has become widespread and is becoming increasingly widespread. It is common for laptop computers to be carried from home to the office and away on
15 business etc: laptop computers have become much reduced in size and weight but are still bulky to carry and are susceptible to being lost, or forgotten or stolen. Mobile telephones have become small in size and weight but are again susceptible to being lost or forgotten or stolen. Furthermore, modern
20 lifestyles demand ever more convenience in relation to personal computers, mobile telephones etc.

I have now devised arrangements which alleviate the above-noted problems in relation to personal computers and mobile telephones, but may also be used with advantage for
25 personal television and/or radio receiver systems, and for a wide variety of other systems.

In accordance with the present invention, there is provided a textile thread or fibre having a plurality of elements embedded or encapsulated therein, or a piece of fabric
30 or a fabric article having a plurality of elements embedded or encapsulated in textile threads or fibres thereof, said plurality of elements being interconnected or otherwise intercommunicating to form a signal processing system.

The embedded or encapsulated elements will typically comprise active elements and may comprise electronic integrated circuits. It is nowadays possible to manufacture such integrated circuits of extremely small size: such an integrated
5 circuit may therefore be embedded or encapsulated within a textile thread or fibre without unacceptably increasing, or increasing at all, the diameter of the thread or fibre at the location of the integrated circuit.

Instead, the embedded or encapsulated elements may
10 comprise optical, molecular, sub-molecular or DNA strand elements, forming an optical, molecular, sub-molecular or DNA strand signal processing system. Such elements may be of biological or non-biological origin or derivation.

Preferably the embedded or encapsulated elements are
15 elongate in shape, aligned lengthwise of the fibre or thread.

The textile thread or fibre may be of unitary form with the system elements embedded in it. Alternatively, the thread or fibre may be formed of a plurality of filaments stranded together and enclosing the system elements.

20 The plurality of system elements may be encapsulated at intervals along the length of the thread or fibre and may be electrically interconnected by electrically conductive filaments extending along the thread or fibre: such filaments may also be embedded or encapsulated within the thread or
25 fibre; where the thread or fibre is formed of a plurality of filaments stranded together to enclose the system elements, some of these filaments may comprise electrically conductive filaments electrically interconnecting the system elements. At least some of the system elements may communicate between
30 each other by radio transmission or by optical transmission (e.g. infrared transmission).

Instead of all elements of the system being carried within a single thread or fibre, these system elements may be distributed over a number of such threads or fibres.
35 Preferably a piece of fabric is formed at least in part from

such threads or fibres, the elements of the different threads or fibres being connected together, or otherwise intercommunicating to form the overall system.

As previously noted, the system elements may be
5 interconnected or otherwise intercommunicate to form (1) a personal computer system, or (2) a personal communications transmitter/receiver system or (3) a television and/or radio receiver system. In accordance with the invention, a garment (such as a coat or jacket) may be made from a textile fabric,
10 one or more threads or fibres of which include elements forming a personal computer system, or a telecommunications transmitter/receiver system, or a television and/or radio receiver system. Two or more pieces of fabric (or two or more garments) may be linked or coupled together to form the system.

15 The system thus incorporated into a garment or piece of fabric will generally include one or more interfaces to associated devices, as follows.

Thus, in the case of a personal computer system, the system elements will typically include one or more
20 microprocessors and one or more program memories. It will further include an interface to a visual display and an interface to a keyboard or other data entry device. It may further include an interface to other memory devices such as disc or tape drive devices: it may include one or more
25 interfaces to other input or output devices, e.g. scanners, printers; it may include a modem. The system may include an interface to an external radio transmitter/receiver, and/or an interface to an external processor.

In the case of a personal telecommunications
30 transmitter/receiver (particularly a mobile telephone), the system elements will typically include an interface to a visual display and an interface to a keyboard or other data entry device. Preferably the system elements include a signal transmitter/receiver, connected to an aerial or antenna: the
35 aerial or antenna may be embedded or encapsulated within the

textile thread or fibre or may be provided by one of the filaments from which the thread or fibre is stranded. Interfaces to various other input or output devices and/or an external aerial or antenna may be included.

- 5 In the case of a television receiver system, the system elements will typically include an interface to a visual display and an interface to one or more speakers. Further, an aerial or antenna will be provided, preferably embedded or encapsulated within the textile thread(s) or fibre(s).
- 10 It will be appreciated that, in accordance with the present invention, a garment may be made which incorporates a personal computer system or a mobile phone system or a television and/or radio receiver system (or any combination of these systems). The wearer of the garment will then
- 15 automatically carry his personal computer system etc. with him, with substantially reduced risk of losing it or having it stolen, and with substantially increased convenience. The various devices with which the system must interface, particularly video display, keyboard etc. may themselves
- 20 incorporated into or secured to the garment: for example the video display may be incorporated on one sleeve of the garment, for example where the garment is a coat or jacket. Alternatively, or in addition, the system may interface with external devices which are kept in the home or office, or
- 25 onboard vehicles, trains, aircraft, etc.

The system elements may be arranged to form a wide variety of signal processing systems, whether for personal use or otherwise. For example, the signal processing system may comprise a control system, monitoring system, an alarm or

30 security system, a data recording system or an information presentation system. Such systems may be incorporated into the upholstery or linings of a car or other vehicle or an aircraft or boat etc., or in upholstery, curtaining etc. in the home, office or elsewhere. Such systems may be incorporated into

35 fabric tape, which can then be used in a wide variety of

applications.

In each of the above-described systems, a rechargeable battery/or other current source may be included, embedded or encapsulated within the textile thread(s) or fibre(s), and the system elements preferably include a recharging circuit for the battery or other current source. Preferably the latter circuit acts to recharge the current source continuously, e.g. in response to solar energy, the body heat of a person wearing the garment incorporating the system, or movement of that person. The system may instead be powered from an external current source for example carried by the person wearing the garment, e.g. in a pocket of the garment. In all of the above cases, the current source may comprise a charge storage device, e.g. an electrical capacitor.

Embodiments of the present invention will now be described by way of examples only, in which:

FIGURE 1 is an enlarged schematic view of a portion of a piece of fabric having integrated circuits embedded in fibres thereof;

FIGURE 2 is a schematic block diagram of a personal computer system which may be formed by the integrated circuits of the piece of fabric shown in Figure 1;

FIGURE 3 is a schematic block diagram of a personal telecommunications transmitter/receiver system which may be followed by the integrated circuits of the piece of fabric shown in FIGURE 1; and

FIGURE 4 is a schematic block diagram of a television and/or radio receiver system which may be formed by the integrated circuits of the piece of fabric shown in Figure 1.

Referring to Figure 1 of the drawings, there is shown a portion of a piece of fabric, from which a garment may be formed. The piece of fabric is formed of a number of textile threads or fibres: in the example shown, the fabric is formed by weaving and comprises warp and weft threads or fibres 10, 20; the fabric may instead be formed by knitting or otherwise.

The threads or fibres may comprise natural or synthetic fibres or a mixture thereof.

As shown in Figure 1, some of the threads or fibres 10a,20a have integrated circuits 12,22 embedded or encapsulated in them. These integrated circuits are of miniature or lesser size, such that the diameter of the thread 10a,20a, at the location of each integrated circuit, is not increased (or at least not significantly or unacceptably increased).

The threads or fibres 10,20 may be of unitary form (e.g. mono-filament), with the integrated circuits 12,22 embedded in them. Instead, the threads or fibres may be formed of a plurality of filaments stranded together, the respective threads or fibres 10a,20a enclosing their integrated circuits 12,22.

The integrated circuits 12,22 are of elongate shape, aligned lengthwise of their respective threads or fibres and spaced-apart along them, to maintain the overall flexibility of the threads or fibres. The integrated circuits of each thread or fibre are electrically interconnected by flexible filaments 13,23 extending between them: interconnections (not shown) are also made between the integrated circuits of different threads or fibres. At least some of the integrated circuits may be arranged to communicate by radio or optical transmission.

Collectively, and in one example, the integrated circuits 12,22 may form a personal computer system, a schematic block diagram thereof being shown in Figure 2. In this example, the integrated circuits include one or more microprocessors M and one or more solid state program memory devices S. The integrated circuits also include interfaces I, O for connection to computer peripherals, including a visual display, a keyboard or other input device, a printer or other output device, and a disc drive. The system may include one or more transducers or instruments (e.g. accelerometers, temperature sensors, microphones, cameras, speakers). The

piece of fabric is preferably formed into a garment, such that the garment incorporates the computer system formed by the integrated circuits embedded in the threads or fibres. Two or more pieces of fabric or garments may be connected together or
5 communicate together to form the computer system, particularly for example to form a parallel processing system, or to form a neural network, or a Local Area Network, or even an Extended Area Network.

In another example, the integrated circuits 12,22 shown
10 in Figure 1 may form a personal telecommunications transmitter/receiver system, a schematic block diagram thereof being shown in Figure 3. In this example, the integrated circuits include one or more microprocessors M, one or more solid state memory devices S, an interface I to a keyboard or
15 other data entry device and an interface O to a visual display: the system further comprises a transmitter/receiver sub-system TR, to which an aerial or antenna AN is connected.

In a further example, the integrated circuits shown in Figure 1 may form a personal television and/or receiver system,
20 a schematic block diagram of which is shown in Figure 4. In this example, the integrated circuits include one or more microprocessors M, one or more solid state memory device S, an interface I to controls and interfaces O to a visual display and one or more speakers: the system further comprises a
25 receiver sub-system RX to which an aerial AN is connected.

In each of the systems shown in Figure 2 to 4, a battery or other rechargeable power source BAT is provided, together with a recharging sub-system RE.

Whilst the embodiments shown in the drawings comprise
30 electronic systems formed of integrated circuits, they may instead comprise optical, molecular, sub-molecular or DNA strand systems, formed of optical, molecular, sub-molecular or DNA strand elements, which may be of biological or non-biological origin or derivation.

CLAIMS

- 1) A textile thread or fibre having a plurality of elements embedded or encapsulated therein, or a piece of fabric or a fabric article having a plurality of elements embedded or
5 encapsulated in textile threads or fibres thereof, said plurality of elements being interconnected or otherwise intercommunicating to form a signal processing system.
- 2) A thread, fibre, piece of fabric or fabric article as claimed in Claim 1, in which at least some of said elements
10 communicat  with each other by radio or optical transmission.
- 3) , A thread, fibre, piece of fabric or fabric article as claimed in Claim 1 or 2, in which said elements are elongate in shape and are aligned lengthwise of the or their respective thread or fibre.
- 15 4) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said elements comprise at least one microprocessor element and at least one data memory element.
- 5) A thread, fibre, piece of fabric or fabric article as
20 claimed in any preceding claim in which said elements include an interface to additional devices.
- 6) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, including an aerial or antenna embedded in or encapsulated in the or a said thread or fibre.
- 25 7) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, further including a rechargeable current source embedded in or encapsulated in the or a said thread or fibre.

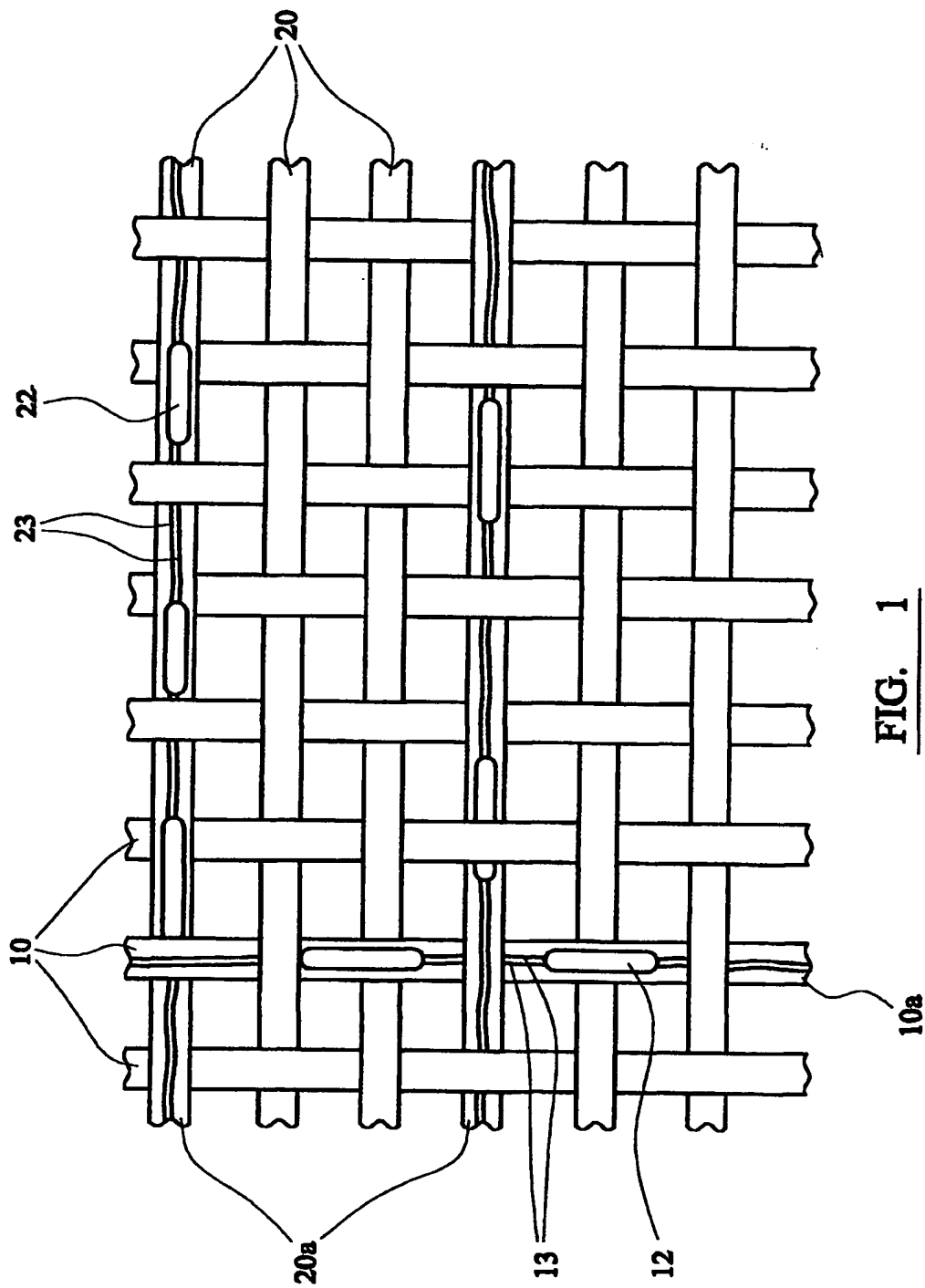
- 8) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which at least some of said elements comprise electronic integrated circuits.
- 9) A thread, fibre, piece of fabric or fabric article as
5 claimed in any preceding claim, in which at least some of said elements comprise optical, molecular, sub-molecular or DNA strand elements.
- 10) A thread, fibre, piece of fabric or fabric article as
10 claimed in any preceding claim, in which said signal processing system comprises a personal computer system.
- 11) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said signal processing system comprises a personal telecommunications transmitter/receiver system.
- 15 12) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said signal processing system comprises a personal television and/or radio system.
- 13) A thread, fibre, piece of fabric or fabric article as
20 claimed in any preceding claim, in which said signal processing system comprises a control system.
- 14) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said signal processing system comprises a monitoring system.
- 15) A thread, fibre, piece of fabric or fabric article as
25 claimed in any preceding claim, in which said signal processing system comprises an alarm or security system.

16) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said signal processing system comprises a data recording system.

17) A thread, fibre, piece of fabric or fabric article as
5 claimed in any preceding claim, in which said signal processing system comprises an entertainment system.

18) A thread, fibre, piece of fabric or fabric article as claimed in any preceding claim, in which said signal processing system comprises an information presentation system.

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-2/2-

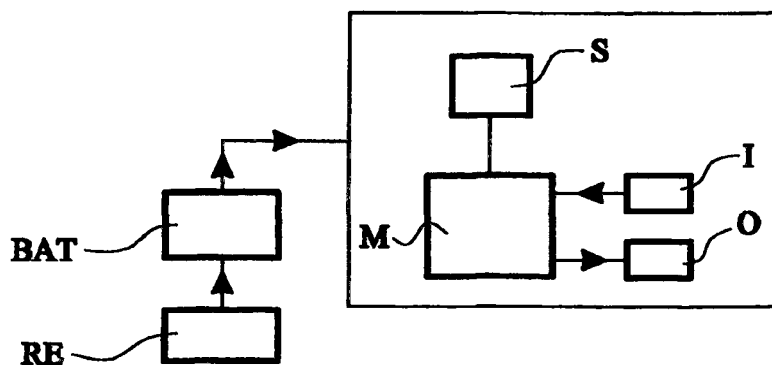


FIG. 2

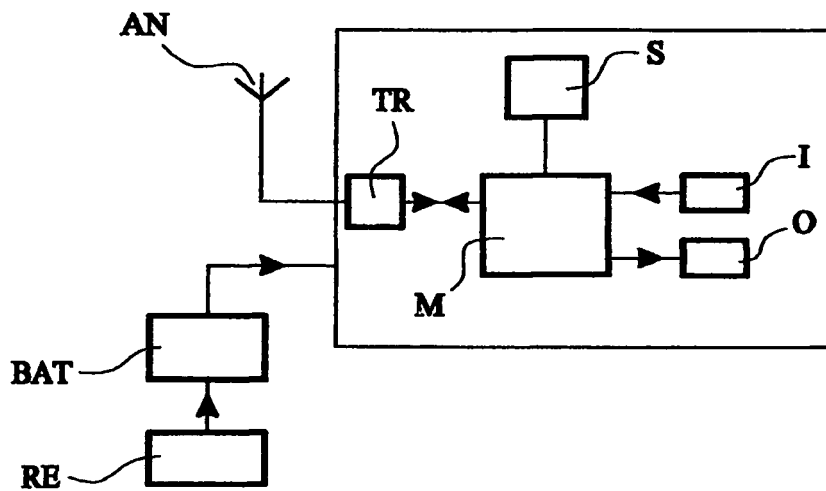


FIG. 3

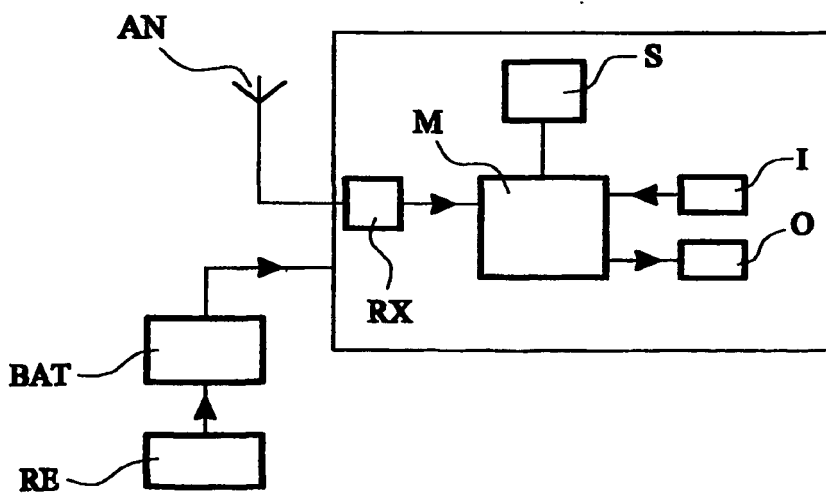


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 02/01658

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08B13/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08B D03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 33155 A (LEONARD PHILIP NOEL) 30 July 1998 (1998-07-30) claims 1-13	1-18
A	US 6 080 690 A (JACHIMOWICZ KAREN E ET AL) 27 June 2000 (2000-06-27) column 3, line 44 -column 4, line 38; figure 1	1-18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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PCT/GB 02/01658

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9833155	A	30-07-1998	AU 724795 B2	28-09-2000
			AU 5673298 A	18-08-1998
			EP 0954836 A1	10-11-1999
			GB 2323254 A ,B	16-09-1998
			WO 9833155 A1	30-07-1998
			US 6329917 B1	11-12-2001
US 6080690	A	27-06-2000	NONE	

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